

SCHLIEREN PHOTOGRAPHS FROM HOLOGRAMS*

J. B. Story, G. S. Ballard, and R. H. Gibbons

Department of Electronics and Instrumentation

University of Arkansas Graduate Institute of Technology

Little Rock, Arkansas

The use of holograms in making schlieren photographs, as suggested by Horman¹, has been accomplished by using the carrier-beam hologram method of Leith and Upatnieks². The schlieren method used was essentially that of Dodd³, who used a pinhole rather than a first knife edge, and an opaque dot on a glass plate instead of a second knife edge. For the purposes of this experiment, the pinhole was omitted and the laser brought to a point focus. This resulted in an unsophisticated apparatus that was satisfactory for demonstrating the principle involved, but gave pictures of poor quality.

The portion of the apparatus that was used for making the hologram is shown in Fig. 1. The wedge deviated one portion of the parallel beam such that it overlapped another portion of the beam that had passed through the schlieren field. When the hologram was viewed, the schlieren head was moved to produce a converging light beam which is shown in Fig. 2. This arrangement caused the light that would have been associated with the virtual image of the schlieren field to be brought to a point focus and subsequently to form a real image of the schlieren field. The reconstruction could have been made using a knife edge instead of a dot at the point focus⁴.

FACILITY FORM 602

N 66-86415

(ACCESSION NUMBER)

10

(PAGES)

AR-68725

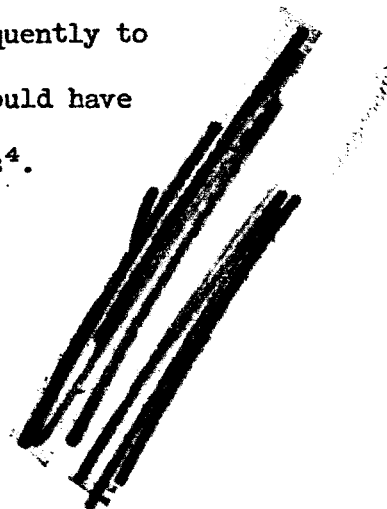
(NASA CR OR TMX OR AD NUMBER)

(THRU)

none

(CODE)

(CATEGORY)




Small dots of ink of known diameter were placed on the glass plate at the point focus to block out the major portion of the light that was not deviated in the schlieren field. The film used in making the holograms was Kodak contrast process panchromatic film (resolution 136-225 lines/mm) instead of the more commonly used Kodak 649F (resolution >2000 lines/mm).

The object viewed in the schlieren field was a hot soldering iron. The reconstruction of the schlieren field without using a dot is shown in Fig. 3. When a series of dots of varying size were introduced at the point focus, a series of different schlieren presentations were obtained (Figs. 4, 5 and 6). Additional presentations were obtained when the dot was placed slightly off-center (Fig. 7).

The advantages of the use of holograms in making schlieren photographs are obvious. A transient phenomenon can be captured in hologram form, and a maximum amount of information can be extracted from it by making a series of reconstructions using a variety of adjustments, including the viewing of schlieren fields separated in depth.

* This note is based on work supported by NASA Grant Nsg 713



REFERENCES

- ¹ Melvin H. Horman, Applied Optics 4, 333-6 (1965).
- ² Emmett N. Leith and Juris Upatnieks, J. Opt. Soc. Am. 53, 1377-81 (1963).
- ³ Jack G. Dodd "The Schlieren Microscope" to be published in The Microscope and Crystal Front.
- ⁴ Richard T. Goddard and Arthur J. Wennerstrom, AF Research Review, Vol. IV, No. 8, pp. 7-9, October 1965.

LIST OF ILLUSTRATIONS

- Figure 1 - Making the Hologram of the Schlieren Field
- Figure 2 - Reconstructing the Schlieren Field
- Figure 3 - Reconstruction of Schlieren Field without Dot at Point Focus
- Figure 4 - Reconstruction of Schlieren Field with Dot (0.0102 cm dia.)
at Point Focus
- Figure 5 - Reconstruction of Schlieren Field with Dot (0.0421 cm dia.)
at Point Focus
- Figure 6 - Reconstruction of Schlieren Field with Dot (0.0975 cm dia.)
at Point Focus
- Figure 7 - Reconstruction of Schlieren Field with Dot (0.0356 cm dia.)
Slightly off Center from Point Focus

FIGURE 1

MAKING THE HOLOGRAM OF THE SCHLIEREN FIELD

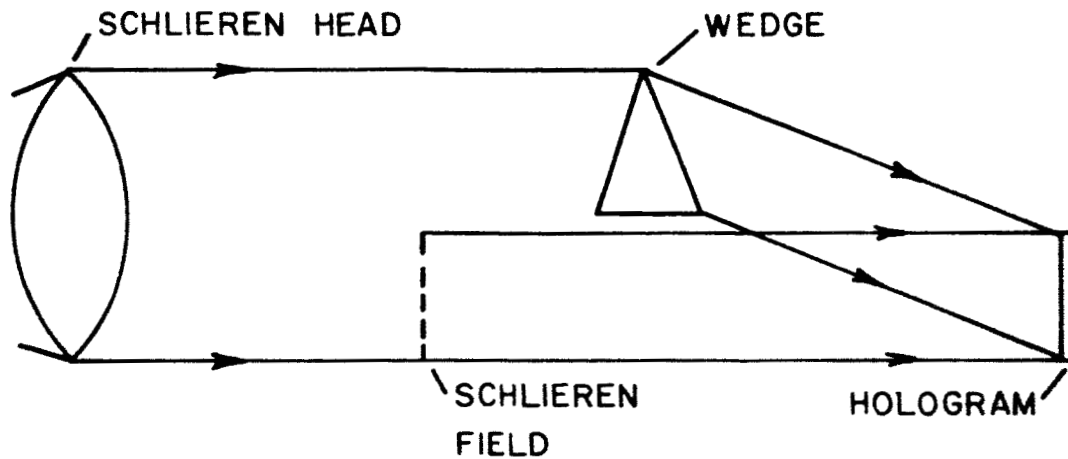
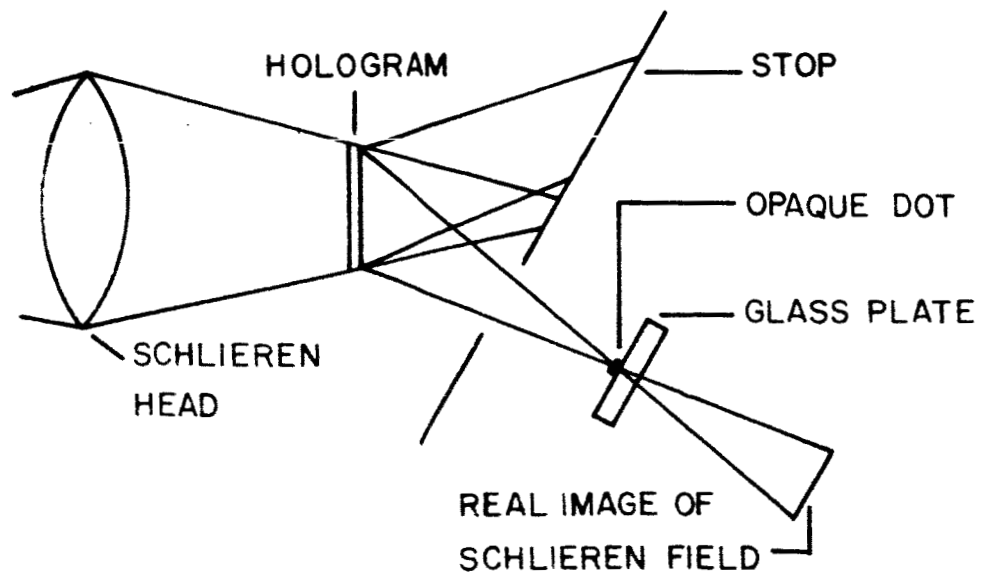


FIGURE 2

RECONSTRUCTING THE SCHLIEREN FIELD



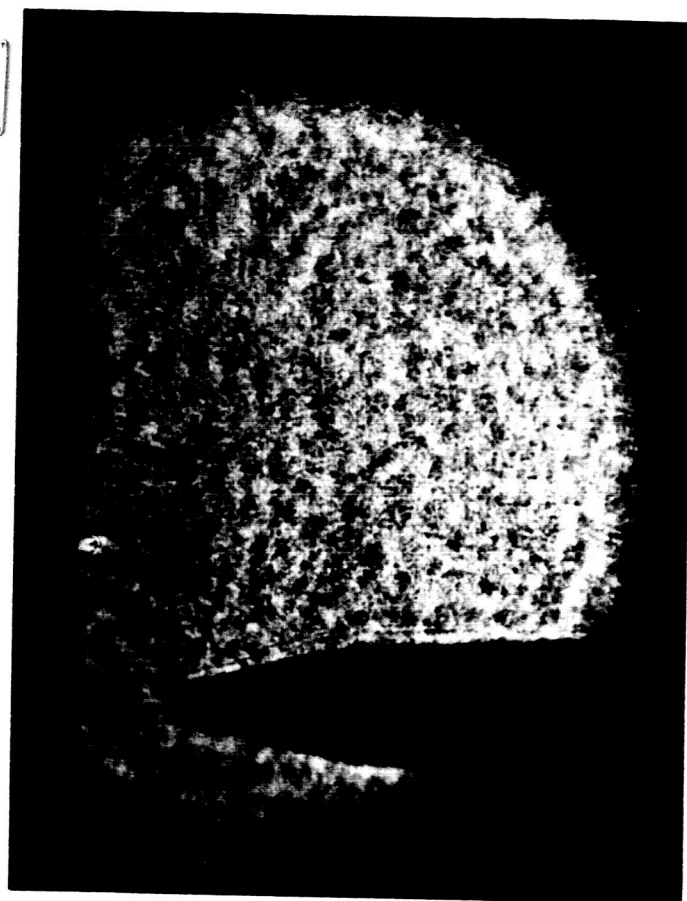


Figure 3
RECONSTRUCTION OF SCHLIEREN FIELD
WITHOUT DOT AT POINT FOCUS

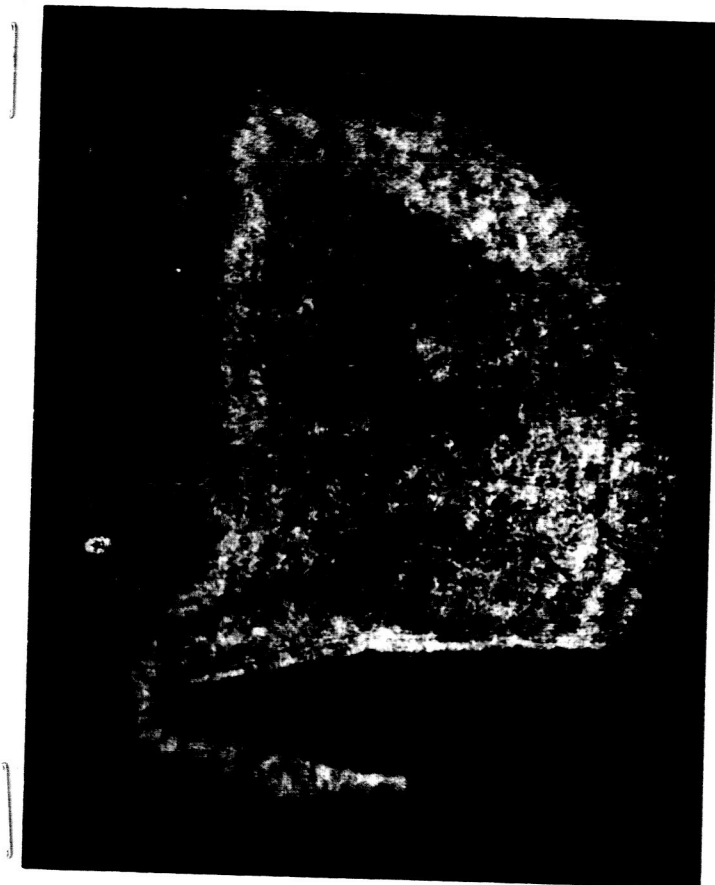


Figure 4

RECONSTRUCTION OF SCHLIEREN FIELD WITH
DOT (0.0102 CM. DIA.) AT POINT FOCUS

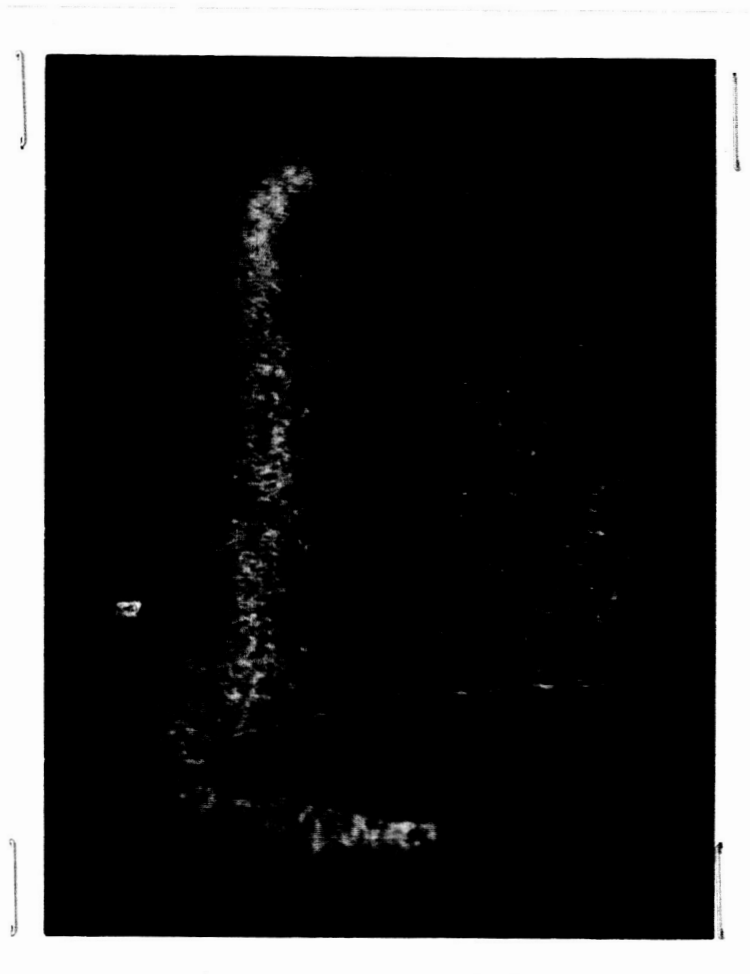


Figure 5
RECONSTRUCTION OF SCHLIEREN FIELD WITH
DOT (0.0421 CM. DIA.) AT POINT FOCUS



Figure 6
RECONSTRUCTION OF SCHLIEREN FIELD WITH
DOT (0.0975 CM. DIA.) AT POINT FOCUS

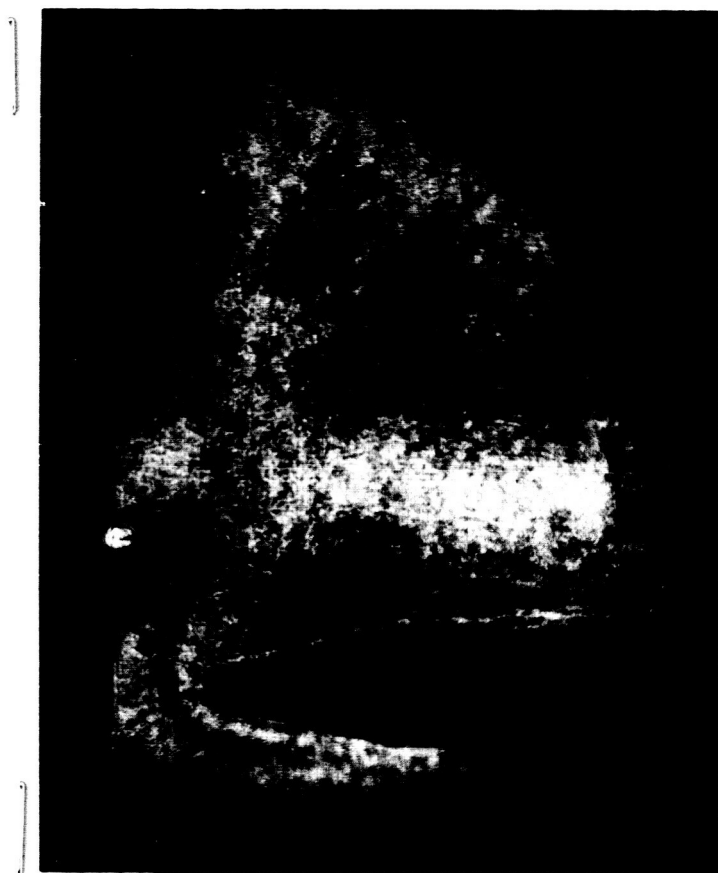


Figure 7
RECONSTRUCTION OF SCHLIEREN FIELD WITH DOT (0.0356
CM. DIA.) SLIGHTLY OFF CENTER FROM POINT FOCUS